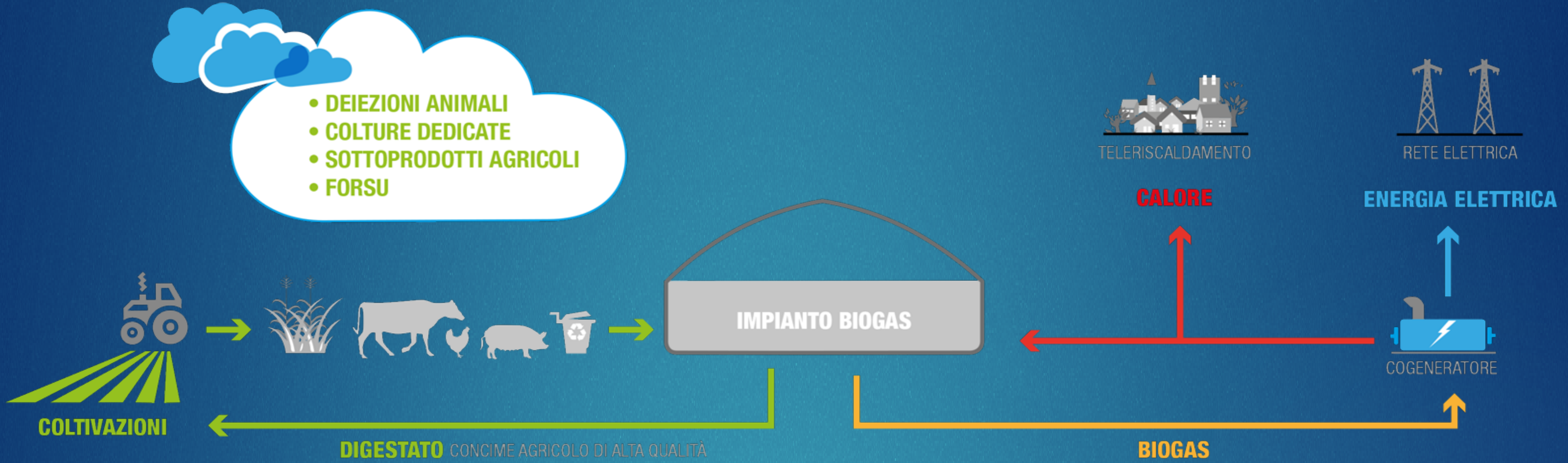


Biogas production from biomasses

Biogas is a mixture of carbon dioxide, methane and other gases, produced by mean microbial fermentation, operated by microorganisms, in particular methanogenic bacteria, of biomass of various origins such as agricultural manure, dedicated crops, agricultural by-products and OFMSW (Organic Fraction of Municipal Waste), i.e. from waste of domestic origin.



ALIMENTAZIONE

PRODUZIONE BIOGAS

ENERGIA DEL BIOGAS

Our work is aimed to built a small-scale digester (see video) (Photo 1) to study the stages of biogas development. Setting up a bubbler (Photo 2) we measured the pH of the water (Photo 3) at time zero obtaining the value of 6.75.

The gurgling of the biogas began about an hour after the start of the experiment, initially slow (see video). The next day the water pH had a value of 6.15. The Carbon dioxide developed react with water such as: $CO_2 + H_2O \leftrightarrow H_2CO_3$. Carbonic acid is unstable, therefore it dissociates into bicarbonate ions and hydrogen ions lowering the pH.

After several weeks, the gurgling of the biogas had increased considerably (see video) and we demonstrated the production of CO_2 : by bubbling gas in a test tube containing barium hydrate in solution. The CO_2 reacts with the formation of barium carbonate which, being insoluble from a white precipitate (Photo 4) $CO_2 + Ba(OH)_2 \rightarrow BaCO_3 \downarrow + H_2O$

After a few more weeks, the production of methane begins. It can be seen by the production of a flame (Photo 5). The diagram shows the main phases of the transformation of biomass into biogas by microbial biocoenosis. The CO_2 production takes place from the early stages, together with various organic acids. CH_4 is only formed at a later stage.



Foto 1 Digester set up

Foto 2 Bubbler set up

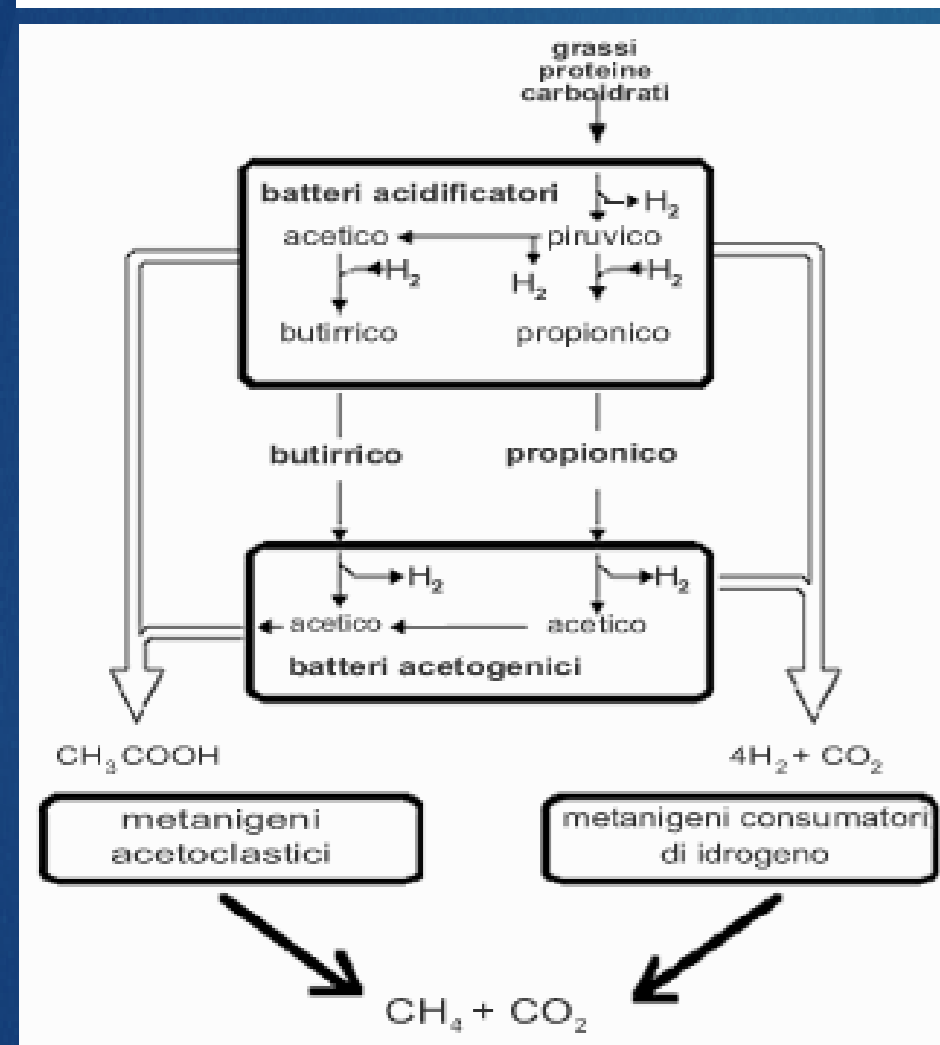


Foto 3 Measuring pH

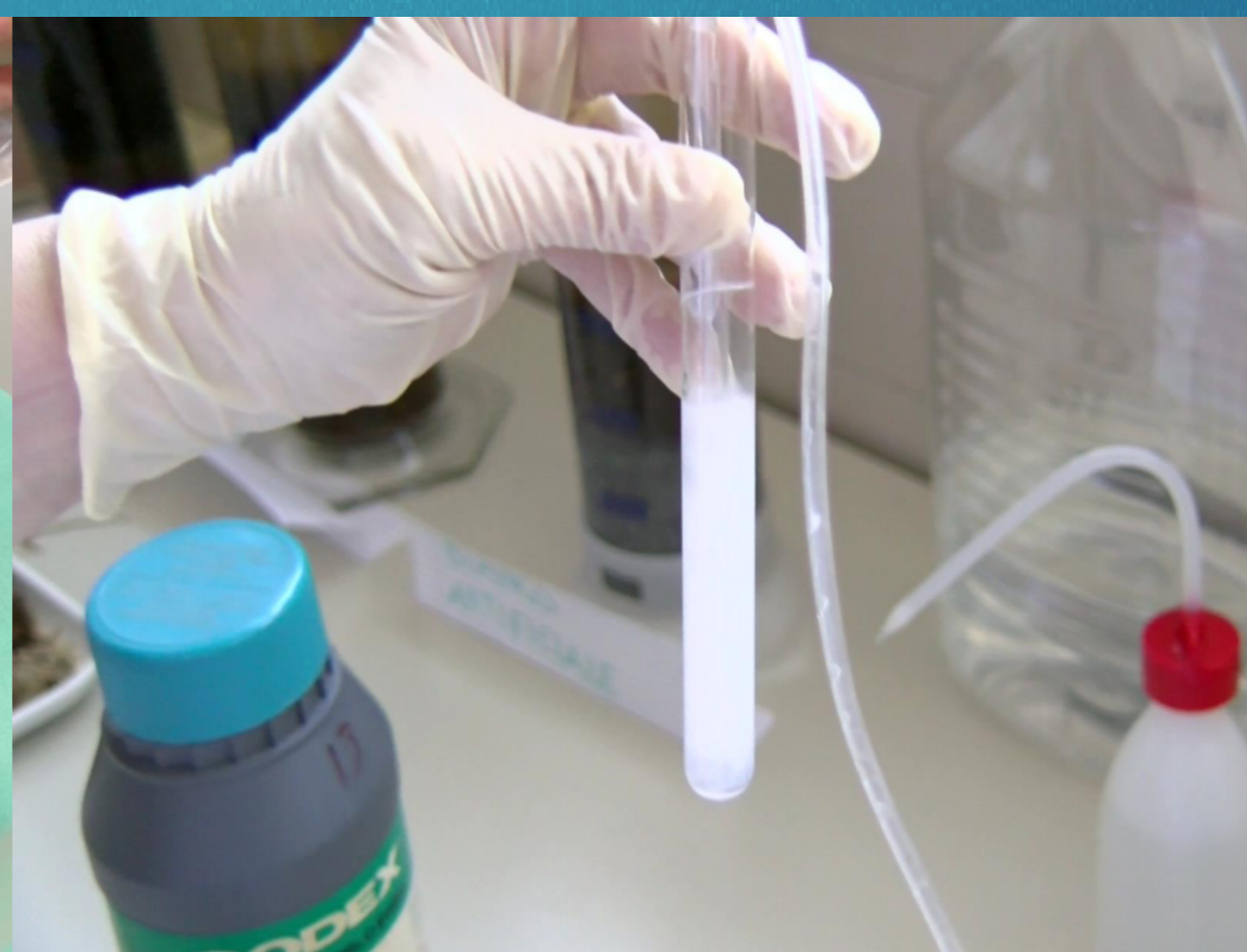


Foto 4 BaCO₃ precipitate



Foto 5 CH₄ production

Conclusions

Carbon dioxide and methane are two powerful climate-altering gases. In fact, they have a significant influence on the increase in the greenhouse effect. The production of biogas, a source of renewable energy, has two positive aspects, both of which contribute to the reduction of the excess greenhouse effect.

The first aspect is due to the fact that biogas, and the biomethane that can be derived from it, are used directly as fuels or for cogeneration of energy (see diagram above) reducing the use of fossil fuels such as oil and coal.

In addition, biomass in general, and particularly livestock manure in areas with intensive farming, released into the environment constitute serious forms of air pollution due to the high quantities of carbon dioxide and methane released into the environment as a result of natural transformation processes. The controlled transformation of biomass into biogas and biomethane in anaerobic digestion plants therefore allows the storage of these gases for their use, avoiding release into the environment.

Both the non-use of fossil fuels and the non-emission of CO_2 and CH_4 into the atmosphere contribute to the fight against climate change. With this in mind, one of the most important issues on the world agenda after the entry into force of the Paris Agreement, biogas is indicated by international institutions as one of the main resources that can guarantee energy autonomy and the gradual reduction of the current state of air pollution and the greenhouse effect. The biogas industry, therefore, will increasingly play a decisive role in the energy transition, in the process towards decarbonization and in the green and circular economy.

